In re Patent Application of:
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IN THE DESCRIPTION

Page 6, lines 25 to 27

According to one broad aspect, the invention provides a photonic device comprising at least one integral waveguide formed from a REDGIVN (rare earth doped group iv nanocrystal) material.

Page 7, lines 8 and 9

In some embodiments, the at least one wave guide is ~~are~~ arranged to form an optical splitter.

Page 7, lines 18 to 23

~~In some embodiments, the photonic device comprises a substrate and/or bottom cladding, a layer containing the REDGIVN material, and a lateral containment element adapted to laterally confine light to a region within the layer containing the REDGIVN material where the at least one wave guide is to be defined.~~

Page 11, lines 10 to 13

Figure 4 is a cross section of the broadband optical pump of Figure 3; [and]

Figure 5 is a side view of a planar optical amplifier provided by an embodiment of the invention;

Figure 6 is a side view of a planar optical amplifier including a Holographic Optical Element (HOE) provided by another embodiment of the present invention; and

Figure 7 is a side view of a planar optical amplifier including a HOE provided by another embodiment of the present invention.

Page 11, line 15 to Page 12, line 6

Applicants U.S. provisional application No. 60/441,413 ~~<attorney docket 50422-1>~~ entitled "Preparation of type IV Semiconductor Nanocrystals Doped with Rare-earth Ions and Product Thereof" filed January 22, 2003 teaches methods of preparing group IV semiconductor nanocrystals doped with rare-earth ions. In one embodiment provided in that application, the invention provides a doped type IV semiconductor nanocrystal layer. In another aspect, the invention provides a doped type IV semiconductor nanocrystal powder comprising crystals of a group IV element that bear on their surface atoms of one or more rare earth elements. The powder can also be used to form a layer, for example by including the powder in a layer of a dielectric medium for example spun glass, or a polymer. That application is incorporated herein in its entirety by reference. Two regular U.S. applications Nos. 10/761,408, and 10/761,275 ~~<attorney dockets 50422-7; 50422-8 >~~ based on the above provisional have been filed the same day as this application and are hereby incorporated by reference in their entirety. In the entire description that follows, whenever a rare-earth doped group IV semiconductor nanocrystal material (REDGIVN material) is referred to, any material taught in the incorporated documents is contemplated.

Page 12, lines 14 to 18

This embodiment provides a planar optical circuit that is manufactured by using group IV semiconductor nanocrystals that are doped with rare-earth ions, and more generally any

material generated/described in the above referenced incorporated applications, i.e. REDGIVN.

Page 13, lines 5 to 24

In a preferred embodiment, the use of the above-described nanocrystals is employed in conjunction with a more conventional broadband light source to pump the Si nanocrystals rather than an expensive laser to pump one of the narrow absorption bands of the Er^{3+} ions. In a preferred embodiment, inexpensive long life visible wavelength LEDs are used which might have a broadband emission wavelength of about 20 nm for example compared to typical narrow band optical sources having emissions focused ~~focussed~~ within about 2 nm. This reduces the cost of the planar circuit greatly and also allows for a much easier assembly of the circuit. In a preferred embodiment, the planar circuit is pumped transversely from a top surface rather than trying to couple the pump light coaxial as is done with the pump laser EDFA and EDWA. The sensitizer Si nanocrystals also provide the refractive index contrast necessary for the wave guiding. One observes gain in the 1.54 ~~Hm~~ µm wavelength that is coupled into the wave guide when the wave guide is pumped from the top, and demonstrates that such a wave guide satisfies all of the three aforementioned conditions necessary for a practical device.

Page 16 lines 14 to 22

This embodiment of the invention provides a broad band optical pump source that is used to excite group IV semiconductor nanocrystals that are doped with rare-earth ions. The purpose of this technology is to allow one to

develop an inexpensive method of pumping planar optical amplifiers that could be used in the telecommunication field but not limited to just that field. This technology could also be used in advanced high speed back-planes and other high speed hybrid optoelectronic circuits.

Page 17, lines 4 to 15

Each LED can be of a single or multiple wavelengths that cover the particular absorption band of the type IV semiconductor nanocrystals. For example, the ~~he~~ pump wavelength of choice for silicon nanocrystals in the near UV and blue region running from about 320 nm to 500 nm, although one could use other LED sources for example a source with light output at 670 nm at a reduction in pump efficiency. The pump source can be a single source or multiple emitter sources ~~source~~ configured to illuminate the optical active gain media by being in close proximity to the gain media and/or by using micro-optics to gather and redirect the pump source to the gain media by refraction or reflective and/or diffractive means.

Page 18, lines 5 to 15

A cross section of the LED pump chamber of Figure 3 is shown in Figure 4. Here, one of the LEDs 30 is shown together with the coupling optics 42 ~~40~~ in the form of a microlens, and the substrate 52 within which four doped Si nanocrystal wave guides are defined. More generally, at least one channel is defined, either in or on the substrate. The reflection chamber, or micro-reflector 53 is more easily seen in this view. This keeps light in the arrangement. It might, for example, be an aluminized piece of glass, or polished metal.

The arrangement can be implemented without this component, but with reduced efficiency.

Page 18, line 21 to Page 19, line 9

Referring now to Figure 5 shown is a planar optical amplifier provided by an embodiment of the invention. This embodiment features a silicon substrate 60. Upon this is formed a wave guide structure comprising a bottom cladding layer 62, a core REDGIVN layer 69 ~~64~~ for example consisting of doped SRSO film, and a top cladding layer 66. More generally, any suitable substrate can be employed and the core contains group IV semiconductor nanocrystals that are doped with rare-earth ions. Also shown are ~~is~~ an input fiber 70 interfacing with a first end of the arrangement, and an output fiber 72 interfacing with a second end of the arrangement. More generally any optical coupling means can be employed for an input and output to the device. Also shown is a set of LEDs 68. With LEDs 68, the arrangement of Figure 5 is not that different from the arrangement of Figure 3. However, in another embodiment, the pump source 68 is an electrical pump source. This requires that the top and bottom cladding 66 and 62, respectively, be conductive, and the substrate 60, if present, also be conductive, such that electric field can be applied across the core REDGIVN layer 69. For example, the cladding 62 and 66 might be ZnO or AlN, and the substrate 60 might be n+ or p+ doped silicon.

Page 19, lines 10 to 24

Another embodiment provides a method of efficiently combining input light signals into a combined light signal, the combined light signal then being used as an optical pump source for the REDGIVN. The method operates without any fiber

gratings or other spectral filtering devices between the sources and the combiner device. Instead of gratings in the input fibers, the invention provides wavelength selection by the LED broadband sources. The method operates to self-align the operational wavelengths of the LED sources to the acceptance angle characteristics of the input lens, the lens functioning as a combiner. The lens may for example have a Plano-convex aspherical cylindrical design that has a small F# and short focal length to re-image the LED source and or sources to a planar output plane where the amplifying medium is located, wherein F# is a ratio of the lens focal length to the lens diameter.

Page 19, line 25 to page 20, line 4

In a preferred embodiment of the invention, such as shown by way of example in Figures 3 and 4, a single or multiple micro-reflectors 53 are employed to efficiently combine input light signals into a combined light signal. The method operates without any fiber gratings or other spectral filtering devices between the sources 30, 32, 34, 36 and 38 and the combiner device 53. Instead of gratings in the input fibers, the invention provides wavelength selection by the LED broadband sources 30, 32, 34, 36 and 38. The method operates to self-align the operational wavelengths of the LED sources 30, 32, 34, 36 and 38 to the acceptance angle characteristics of the micro-reflectors 53. The micro-reflector 53 is a convex aspherical cylindrical design that has a small F# and short focal length to re-image the LED source and or sources to a planar output plane where the amplifying medium ~~median~~ is located.

Page 20, lines 5 to 16

In a preferred embodiment of the invention, illustrated in Figure 6, a combiner 81 is provided in the form of a single or multiple broadband Holographic Optical Element (HOE)'s, which are located after (downstream from) the LED source 68 and or sources for combining the light into the amplifying element, i.e. REDGIVN layer 69. Alternatively, as illustrated in Figure 7, ~~Thus,~~ the combiner device 82 is located between the pump LED 68 and or LEDs and the optical amplifying element. The diffraction of the combiner device 81 or 82 (through the respective input ports) determine the wavelengths of the broadband light provided by the LED 68 and or LEDs, such that the LED wavelengths are at the minimum loss wavelengths associated with the combiner device 81 or 82. Thus, efficient diffraction concentration can be obtained independent of operating temperatures, age of the system, etc.